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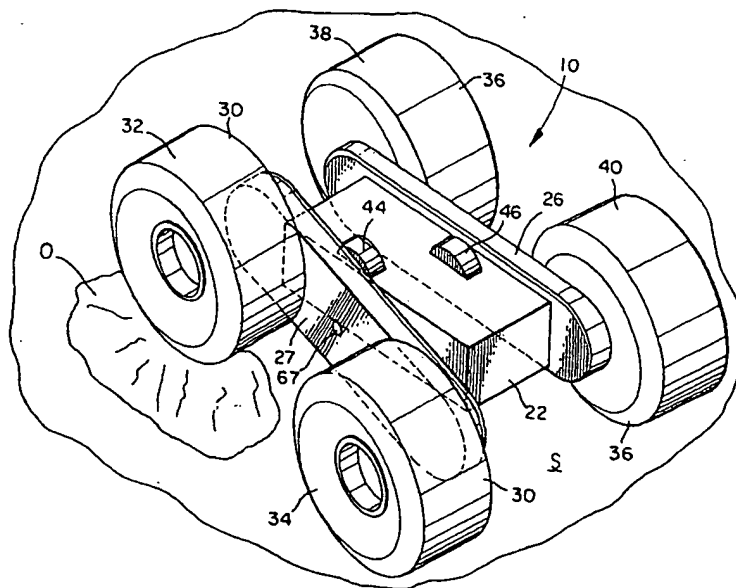
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(54) Title: TOY VEHICLE WITH PIVOTALLY MOUNTED SIDE WHEELS



## (57) Abstract

A radio-controlled toy vehicle (10) is provided with four non-steerable wheels (30), two on each lateral side (24, 26) of the vehicle. The wheels (30) on each lateral side are drivingly coupled with a separate reversible motor (44, 46). The vehicle is steered by controlling the operation and direction of each motor. Pivoting beam (27) is centrally located on one lateral side with the wheels (32, 34) on that side being rotatably attached to the beam. The pivoting beam (27) provides for infinite ranges of suspension positions. The vehicle proceeds until it encounters an obstacle and depending upon the size of the obstacle relative to the size of the wheels (30), the vehicle either rolls over the obstacle or climbs up the obstacle and flips over. Two beams (20, 200) may be provided, each supporting a pair of front and rear wheels on separate lateral side of the vehicle.

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## TITLE OF THE INVENTION

## TOY VEHICLE WITH PIVOTALLY MOUNTED SIDE WHEELS

## BACKGROUND OF THE INVENTION

5                   Radio controlled toy vehicles are well known and have grown to constitute a significant specialty toy market.

                  Toy manufacturers attempt to duplicate well known vehicles, as well as the latest in automotive developments, including specialty entertainment vehicles. In addition, manufacturers constantly seek new ways and features to add innovative action to such toys to make such vehicles more  
10                   versatile and/or entertaining.

                  U.S. Pat. No. 5,429,543, for example, discloses a remote controlled toy vehicle with six wheels, three wheels on each side. The vehicle is balanced such that the vehicle is normally supported by the center pair of  
15                   wheels and the rear pair of wheels. The vehicle is dynamically balanced such that when the wheels of the center pair are driven in opposite directions, the vehicle pitches forward and the vehicle is supported only by the central pair of wheels. The vehicle spins rapidly on the central pair of wheels about a central vertical axis.

20                   U.S. Pat. No. 5,762,533, for example, discloses a remote controlled toy vehicle with wheels that are adjustably eccentrically mounted on the chassis relative to the axis of rotation of each wheel. This adjustable eccentric mounting permits various permutations of wheel locations relative to

the chassis, providing different handling characteristics of the vehicle for each wheel location.

U.S. Patent No. 5,727,985, for example, discloses a remote controlled toy vehicle having a chassis with two "front" and two "rear" wheels with balloon tires. The tires are resilient and can be elastically compressed against an obstacle. The wheels are mounted on the chassis such that the tires define an outer perimeter of the vehicle. The location of the chassis wholly within the perimeter; no portion of the vehicle extends beyond the outer perimeter. The resiliency of the tires allows the vehicle to perform a variety of tumbling and deflecting maneuvers.

#### BRIEF SUMMARY OF THE INVENTION

In one embodiment, the present invention is a toy vehicle comprising a chassis having first and second lateral sides; a first pair of wheels rotatably mounted on the first lateral side; a second pair of wheels rotatably mounted on the second lateral side; a prime mover on the chassis drivingly coupled with at least one wheel of the first pair of wheels; and a first beam pivotally mounted to the first lateral side, the first pair of wheels being rotatably mounted on the first beam, distal from the chassis.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings  
5      embodiments which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

Fig. 1 is a perspective view of a first preferred embodiment of the toy vehicle with the body removed;

10              Fig. 2 is a left side elevational view of the toy vehicle;

Fig. 3 is a right side elevational view of the toy vehicle;

Fig. 4 is a plan view, partially broken away, of the toy vehicle as shown in Fig. 1;

Fig. 5 is a sectional view of the toy vehicle along line 5-5 in  
15      Fig. 4;

Fig. 6 is a plan view of a second embodiment toy vehicle;

Fig. 7 is a perspective view of the toy vehicle of Figs. 1-5, with the body removed, climbing over an obstacle;

Fig. 8 is a plan view of a third embodiment toy vehicle;

20              Fig. 9 is a front elevational view of a fourth embodiment toy vehicle;

Fig. 10 is a rear elevational view of the fourth embodiment toy vehicle; and

Fig. 11 is a partial top plan view, partially in section, of the drive mechanism of the fourth embodiment toy vehicle;

Fig. 12 is a sectional view of the toy vehicle taken along line 12-12 of Fig. 11.

5

## DETAILED DESCRIPTION OF THE INVENTION

Certain terminology is used in the following description for convenience only and is not limiting. The words "lower" and "upper" designate directions in the drawings to which reference is made. The words "inwardly" and "outwardly" refer to directions toward and away from, respectively, the geometric center of the vehicle and designated parts thereof. The word "a" is defined to mean "at least one". The words "left" and "right", as used herein, correspond to the sides of the vehicle as viewed in Fig. 4. The terminology includes the words above specifically mentioned, derivatives thereof and words of similar import. In the drawings, like numerals are used to indicate like elements throughout.

A first preferred embodiment of a preferred toy vehicle of the present invention capable of performing on a playing surface "S" is indicated generally at 10 in Figs. 1 through 4. The vehicle 10 preferably comprises a substantially integral and rigid chassis, indicated generally at 12, supporting an aerodynamically shaped body, indicated generally at 14 in Figs. 2 and 3. The body 14 may be provided with vehicular detailing, which may be three dimensional (functional or non-functional) or merely surface ornamentation provided to simulate such functional elements. For example,

the body 14 may be provided with such detail as a bank of header pipes, an external fluid cooler (oil, transmission, or both), undercarriage details, etc.

Referring now to Figs. 2 and 3, the body 14 can be one body type and color on a top side 16 and an alternate body type and color on a bottom side 18. Additionally, the body 14 can be in the form of other aerodynamic styles or conventional passenger car, truck, and other vehicle styles. The vehicle 10 may also be equipped with lights (not shown), which are illuminated when the vehicle is being operated. The chassis 12 and the body 14 are constructed of, for example, plastic or any other suitable material, such as wood or metal. The chassis 12 may be integrally formed with an outer skin or body in a monocoque construction or may be separately formed and support a non-load bearing outer skin or body.

The chassis 12 has a front end 20, a rear end 22, a first lateral side 24 (Fig. 2), and a second lateral side 26 (Fig. 3). The two different body types on the top side 16 and the bottom side 18 preferably face opposing directions, one body type facing the front end 20 and the second body type facing the rear end 22.

Referring now to Figs. 1 and 2, a first beam 27 is pivotally mounted to the first lateral side 24 of the chassis 12. A first pair of wheels 30 including a first front wheel 32 and a first rear wheel 34 is rotatably mounted on the first lateral side 24 of the chassis 12 and the vehicle 10. Each of the wheels 30 is rotatably mounted on the first beam 27 at opposing ends of the beam, on a side distal from the chassis 12. Referring to Fig. 3, a second pair of wheels 36 including a second front wheel 38 and a second

rear wheel 40 is rotatably mounted on an opposite side (second lateral side) of the chassis 12 and the vehicle 10 from the first beam 27 and the first pair of wheels 30.

Referring now to Fig. 4, the first beam 27 is pivotally  
5 mounted to the first lateral side 24 of the chassis 12. Preferably first beam 27 is mounted on an axle 62, located approximately halfway between the front end 20 and the rear end 22 such that it can rotate more than 360 degrees around the axle 62 on the chassis 12.

Referring still to Fig. 4, motor means 42 are located on the  
10 chassis 12 and are drivingly coupled with at least one wheel of the first pair 30 and, preferably, with each of the first pair of wheels 30 and the second pair of wheels 36 for selectively driving each of the first pair of wheels 30 and the second pair of wheels 36 selectively and simultaneously at least in one linear direction (forward or reverse), and at least simultaneously in  
15 opposite linear directions. The motor means 42 preferably includes a first prime mover, preferably a first electric motor 44, drivingly coupled with the first pair of wheels 30 and a second prime mover, preferably a second electric motor 46, independently operable from the first motor 44 and drivingly coupled with the second pair of wheels 36. Preferably, the motors  
20 44, 46 are reversible, although those skilled in the art will realize that non-reversible motors can be used, but will decrease the functional capability of the vehicle 10. The wheels 32, 34, 38, and 40 may be made of any suitable material, and are preferably formed from rigid plastic hubs with hollow



resiliently flexible tires which are open to atmosphere so that they might resiliently collapse on impact.

The first motor 44 and the second motor 46 are respectively electrically connected to a controller 47 and may be independently  
5 controlled. Preferably the controller 47 is connected to a radio receiver 48, such as a high frequency receiver circuit, for receiving and processing control signals from a source remote to the vehicle 10, such as a remote control device 50, shown in Fig. 2. The remote control device 50 may have a pair of toggle switches 51, 52, or other similar type switches, to generate  
10 signals separately controlling operation of each of the first motor 44 and the second motor 46.

Referring back to Fig. 4, the controller 47 and the radio receiver 48 are preferably mounted on a PC board 53 located in the vehicle 10. The controller 47, radio receiver 48, remote control device 50, and  
15 electric motors 44 and 46 are entirely conventional and are based on well known, existing radio controlled vehicle designs, such as disclosed in U.S. Patent No. 5,135,427, which is incorporated by reference herein in its entirety. Such control systems can be obtained directly from manufacturers, such as Taiyo Kogyo of Tokyo, Japan and others or U.S. distributors selling  
20 radio control vehicle products and/or parts. Since the vehicle 10 of the present invention uses the same or similar controller circuitry as described in U.S. Patent No. 5,135,427, these elements will not be further discussed herein.

A power source 54 for supplying the vehicle's power, is contained within the chassis 12 for powering both of the electric motors 44, 46 and the circuitry of the controller 47 and radio receiver 48. The power source 54 may comprise a removable set of alkaline or other batteries (not shown) or a conventional rechargeable power pack (e.g. 7.2 volts).  
However, those skilled in the art will realize that other types of power sources can be used.

Each motor 44, 46 is drivingly connected to its respective pair of wheels 30, 36 preferably via a plurality of gears rotatably mounted on the first beam 27 and a like plurality of gears rotatably mounted on the chassis 12. Fig. 5 shows a sectional view of the plurality of gears driving the first pair of wheels 30, which are arranged in a drive train 56, as viewed from the first lateral side 24. A like plurality of gears drives the second pair of wheels 36 and have an identical appearance when viewed from the second lateral side 26. Although the following description only refers to the drive train 56 between the first motor 44, a motor drive pinion 64 and the first front wheel 32, the description also pertains to the drive train between the drive pinion 64 and the first rear wheel 34 as well as the drive train between the second motor 46 and the second front and rear wheels 38 and 40.

Referring now to Figs. 4 and 5, an output shaft 58 of the first motor 44 is fixedly attached to a motor pinion 60 located on the first lateral side 24. The output of the motor pinion 60 drives a main gear 61 which is rotatably mounted to a pivot in the form of the axle 62, which is unpowered

and non-rotating. The axle 62 is mounted to the chassis 12 and is located approximately half way between the front end 20 and the rear end 22. The drive pinion 64 is drivingly connected to the first motor 44 through the main gear 61 and is fixedly mounted to, and co-axial with, the main gear 61, forming a double gear 66. The axle 62 on the first lateral side 24 is internally threaded on an end 65 distal from the chassis 12. The first beam 27 is pivotally mounted on the axle 62. Preferably, a cap screw 67 is threaded onto the end 65 of the axle 62 to pivotally fasten the first beam 27 about the axle 62. However, those skilled in the art will recognize that other fasteners, such as a pressed bushing, can be used.

The drive pinion 64 drives a first idler gear 68 which in turn drives a second idler gear 72. An idler pinion 76 is fixedly mounted to, and co-axial with, the second idler gear 72, forming a double idler gear 73 (Fig. 4). The idler pinion 76 drives a wheel gear 80. The idler gears 68, 72, the idler pinion 76, and the wheel gear 80 are all rotatably mounted to the first beam 27. Preferably, all gear components are made of a plastic or other lightweight polymer, although those skilled in the art will realize that the gear components can be made from other materials as well.

Preferably, the wheel gear 80 is fixedly attached to, and co-axial with, a splined shaft 82. The first front wheel 32 contains a wheel hub 84 concentrically located therein. The wheel hub 84 is keyed such that the splined shaft 82 is slidably locatable through the wheel hub 84 of the first front wheel 32 to provide a non-rotating connection between the splined shaft 82 and the wheel hub 84. An end of the splined shaft 82 located distal

from the chassis 12 is internally threaded. After the splined shaft 82 is slid through the wheel hub 84, a cap screw 86, whose threads match the internal threads of the splined shaft 82, is screwed into the splined shaft 82, fixedly fastening the first front wheel 32 to the wheel gear 80. However, those  
5 skilled in the art will recognize that other fasteners, such as a pressed bushing, can be used. The wheel gear 80 thus drivingly couples the wheel 32 to the drive pinion 64.

The drive train between the drive pinion 64 and the wheel hub 84 of first rear wheel 34 is a mirror image of the drive train 56 between  
10 the drive pinion 64 and the wheel hub 84 of first front wheel 32. The second front wheel 38 and the second rear wheel 40 are identically driven except that, on the second lateral side, idler gears 68, 72, idler pinion 76, and wheel gear 80 are all rotatably mounted to the chassis 12 instead of the separate, pivotally mounted beam 27.

15 Preferably, the wheels 32, 34, 38, and 40 are driven by gears. However, those skilled in the art will understand that belts or other forms of power transmission can be used to transfer the power from the motors 42, 44 to the wheels 32, 34 and 38, 40, respectively, without departing from the scope of the invention. Additionally, it is preferred that the gears are spur  
20 gears, but those skilled in the art will understand that other types of gears, including, but not limited to, bevel gears as well as drive shafts may also be used.

Further, although two idler gears 68, 72 are disclosed between the drive gear 61 and the wheel gear 80 in each drive train 56, any

number of idler gears may be used between the drive pinion 64 and the wheel gear 80, so long as the front wheels 32, 38 rotate in the same direction as their respective rear wheels 34, 40, and as long as all wheels 32, 34, 38, and 40 rotate with the same linear speed when rotating in the same direction  
5 when equivalent power is applied from each respective electric motor 44, 46.

Since the preferred electric motors 44 and 46 are reversible and independently controllable, the first pair of wheels 30 and the second pair of wheels 36 can be selectively driven simultaneously in the same  
10 direction or in opposite directions, or one pair of wheels 30 and 36 can be driven while the other pair of wheel 30 and 36 is stationary. In this manner, the vehicle 10 can be made to spin or turn in either direction without the need for any of the wheels 34, 34, 38, and 40 to be steerably mounted to pivot with respect to the chassis 12 about a vertical axis perpendicular to a  
15 plane through the centers of all four wheels and to the plane of Fig. 4.

In operation, both the vehicle 10 and the remote control unit 50 are provided with power switches (not depicted) which are turned "ON". If a user desires the vehicle 10 to proceed forward, the user manipulates the toggle switches 51, 52 on the remote control unit 50 to direct the first motor  
20 44 and the second motor 46, respectively, to rotate in the same direction relative to the vehicle 10. The motors 44, 46 transmit their power through the drive trains 56 located on each of the first lateral side 24 and the second lateral side 26 to the wheels 32, 34, 38, and 40 to rotate the first pair of wheels 30 in one direction, and the second pair of wheels 36 in the same

direction. If the user desires the vehicle 10 to proceed backward, the user operates the toggle switches 51, 52 in an opposite direction, directing the first motor 44 and the second motor 46, respectively, to rotate in the same direction relative to the vehicle 10, but in the opposite direction as for  
5 forward motion.

Since both the first motor 44 and the second motor 46 are independently operable, the vehicle 10 can turn by manipulating the motor directions. To turn the vehicle 10, one motor 44, 46 can be stopped, and the other motor 44, 46 can be operated to pivot the vehicle 10 about a vertical  
10 axis in a longitudinal vertical plane of the wheel pair 30, 36 that is not turning. In the event that the user desires the vehicle 10 to turn faster than the turning operation described above, the operator can direct one motor 44, 46 forward, and the other motor 44, 46 in reverse, rotating the first wheel pair 30 in one direction and rotating the second wheel pair 36 in the opposite  
15 direction, causing the vehicle 10 to swiftly rotate about the vertical axis 90. As an alternate turning method, the user can operate one motor 44, 46 at full power, and operate the other motor 44, 46 in the same direction at partial power, causing the vehicle 10 to rotate in the direction of pair of wheels 30, 36 whose respective motor 44, 46 is operating at partial power. This turning  
20 capability permits the wheels 32, 34, 38, and 40 to rotate without the need for any of the wheels 32, 34, 38, 40 to be steerably mounted to pivot with respect to the chassis 12 about the vertical axis 90.

As shown in Fig. 7, in the event that the first front wheel 32 encounters an obstacle O which is small relative to the first front wheel 32,

the first front wheel 32 rolls over the obstacle O. The first beam 27 pivots about the axle 62 upward at the first front wheel 32, keeping the first rear wheel 34 and the second pair of wheels 36 on the surface S as the first front wheel 32 traverses the obstacle O. The pivoting capability of the first beam 5 27 provides for an infinitely variable range of suspension travel, with all wheels 32, 34, 38, and 40 maintaining contact while adapting to the terrain.

In the event that the first front wheel 32 encounters an obstacle O which is large relative to the first front wheel 32, which precludes continued forward motion of the first front wheel 32, the drag on 10 the wheel 32 causes the beam 27 to be rotated by the motor 44 about the axle 62 to raise the first front wheel 32, driving the first front wheel 32 up the object O and bringing the first rear wheel 34 underneath the first front wheel 32. When the first rear wheel 34 is sufficiently below the first front wheel 32, the first beam 27 will flip over, exposing a bottom side 29 of the 15 first beam 27.

If the second front wheel 38, which is fixed with respect to the chassis 12, encounters an obstacle O which is large relative to the size of the second front wheel 38, the second front wheel 38 will continue to rotate, causing the chassis 12 to climb up the obstacle O. If the second rear wheel 20 40 of the chassis 12 moves sufficiently under the second front wheel 38, the chassis 12 will flip backwards, exposing the bottom side 18.

If both the first front wheel 32 and the second front wheel 38 encounter an obstacle O, such as a wall, which is large relative to the size of the first front wheel 32 and the second front wheel 38, both the first front

wheel 32 and the second front wheel 38 will continue to rotate, causing the vehicle 10, including the chassis 12 and the first beam 27, to climb up the obstacle O. When the rear wheels 34, 40 are sufficiently below the front wheels 32, 38, both the chassis 12 and the first beam 27 will flip backwards, exposing the chassis bottom side 18 and the beam bottom side 29. The vehicle 10 will repeat the process of climbing and flipping until the obstacle O is removed from the path of the vehicle 10 or the vehicle 10 is turned away from the obstacle O.

In a second embodiment vehicle 210, as shown in Fig. 6, a second beam 200 can be pivotally mounted to a second lateral side 226 of a chassis 212. The second pair of wheels 36 and its respective drive train can be moved from the chassis 212 to the second beam 200 in a configuration similar, if not identical, to the configuration in the drive train 56 which is shown in Fig. 5, with the second pair of wheels 36 being rotatably mounted to the second beam 200, distal from the chassis 212. The second beam 200 can also be pivotable on the chassis 212 on the second lateral side 226 approximately halfway between the front end 20 and the rear end 22 of the chassis 212.

Operation of the second embodiment is similar to the operation of the first embodiment with the exception that, if only the second pair of wheels 36 encounters an obstacle, only the second beam 200, and not the entire chassis 212, pivots.

In a third embodiment, shown in Fig. 8, a single motor 44 is used to drive the vehicle 310. The motor 44 is drivingly connected with the



drive train 56 on the first lateral side 24 of the vehicle 310. A first end of a through-shaft 101, fixedly attached to main gear 61, extends through the width of the vehicle 310, where a second end of through-shaft 101 is rotatably attached to a main gear 61'. A counter-clockwise one-way clutch 102 is rotatably mounted about the through-shaft 101 and is fixedly attached to the main gear 61'. A clockwise one-way clutch 104 is rotatably mounted about the through shaft 101 and is fixedly attached to a clutch spur gear 106. Main gear 61', counter-clockwise one-way clutch 102, clockwise one-way clutch 104, and clutch spur gear 106 are all co-axial about the through-shaft 101. A first clutch idler gear 108 is rotatably connected to the clutch spur gear 106. A second clutch spur gear 110 is rotatably connected to the first clutch idler gear 108 and to the main gear 61'.

In operation, the motor 44 drives the gear train 56 on the first lateral side 24 as previously described herein. When the user desires the vehicle 310 to proceed forward, the motor 44 drives the main gear 61 in a clockwise direction when viewed from the first lateral side 24. Clockwise rotation of the main gear 61 when viewed from the first lateral side 24 rotates the first pair of wheels 30 in a counter-clockwise direction. The counter-clockwise clutch 102 engages the through-shaft 101 with the main gear 61', driving the main gear 61' in a clockwise direction when viewed from the first lateral side 24. The clockwise clutch 104 does not engage with the shaft 101 and merely spins about the through-shaft 101. By driving main gear 61' in a clockwise direction when viewed from the first lateral

side 24, the second pair of wheels 36 rotate in a counter-clockwise direction and the vehicle 310 proceeds in a forward linear direction.

When the user desires the vehicle 310 to turn, the motor 44 drives the main gear 61 in a counter-clockwise direction when viewed from the first lateral side 24. Counter-clockwise rotation of the main gear 61 rotates the first pair of wheels 30 in a clockwise direction. The clockwise clutch 104 engages the through-shaft 101 with the clutch spur gear 106, rotating the clutch spur gear 106 in a counter-clockwise direction. The counter-clockwise clutch 102 does not engage with shaft 101 and merely spins about through-shaft 101. Clutch spur gear 106 drives first clutch idler gear 108, which in turn, drives second clutch idler gear 110 in a counter-clockwise direction. The second clutch idler gear 110 thus drives main gear 61' in a clockwise direction when viewed from the first lateral side 24. By driving main gear 61' in a clockwise direction when viewed from the first lateral side 24, the second pair of wheels 36 rotate in a counter-clockwise (forward) direction and the vehicle 10' turns approximately about the central vertical axis through chassis 12. Idler gears 108 and 110 provide a speed reduction between clutch spur gear 106 and main gear 61'. This speed reduction provides for increased torque for the second pair of wheels 36 compared to the first pair of wheels 30.

A fourth embodiment of the invention is identified as vehicle 410, as shown in Figs. 9-12. Referring now to Figs. 9 and 10, the body 114 can be one body type and color on a top side 116 and an alternate body type and color on a bottom side 118. Preferably, the body type on the top side

116 displays a top of a vehicle with cockpit and the body type on the bottom side 118 displays a bottom of a vehicle with crash bars, simulated transmission and oil pan and the like, making the toy vehicle 410 more life-like in appearance.

5                   Referring to Figs. 11 and 12, the vehicle 410 includes a locking lever 120 which releasably locks a first beam 127 to the chassis 112. As shown in Fig. 11, the locking lever 120, is located on the first beam 127. As shown in Fig. 12, the locking lever 120 is shiftable between two positions, a first, disengaged position as shown in solid lines and a second, engaged position as shown in phantom lines. A separating plate 125, which  
10                   is attached at one end to the beam 127, separates the first and second positions. The locking lever 120 includes a first end 122 which is pivotally attached to the beam 127 at a connection 124 and a second end 126 that extends beyond the first beam 127 and preferably includes a knob 128 that  
15                   the user operates to toggle the locking lever 120 around the separating plate 125 between the first and second positions.

                  The locking lever 120 includes an angled stop plate 130 which is preferably located approximately half-way between the first and second ends 122, 126. The stop plate 130 is engageable with detents 132  
20                   along an outer perimeter of a ring gear 134. Preferably, the detents 132 extend about every 15° around the outer perimeter of the ring gear 134, although those skilled in the art will realize that the detents 132 can extend at different intervals and that the detents 132 need not extend entirely around the ring gear 134.

The ring gear 134 is located within the first beam 127 but is fixedly connected to the chassis 112. The ring gear 134 surrounds, but does not engage, a central axle 162.

When the locking lever 120 is in the first position (in solid in Fig. 12), the beam 127 is free to pivot about the axle 162. When the locking lever 120 is in the second position (in phantom in Fig. 12), the stop plate 130 engages detents 132 and the beam 127 is fixed to the chassis 112. However, the stop plate 130 can slip at least one detent 132 or more while the lever 120 is in the second position to allow the beam 127 to rotate about the axle 162 when a sufficient amount of rotational force is externally applied to either the beam 127 or the chassis 112 (i.e., when the vehicle 410 flips or lands after a jump or being dropped). The feature of allowing the stop plate 130 to slip at least one detent 132 provides for more exciting operational capabilities and also reduces the risk of damaging the vehicle 410 while performing stunts.

It should be noted that the beam 127 can be fixed to the chassis 112 in any position about the ring gear 134 equivalent to the locations of the detents 132. For example, the beam 127 can be rotated ninety degrees from the position shown in Fig. 11, with one of the front and rear wheels located above the other of the front and rear wheels. With the beam 127 in this position, the vehicle 410 is riding on three wheels. Since all of the wheels 32, 34, 38, and 40 are preferably rotating at the same linear speed, and the axles 82 of each of the wheels 32, 34, 38, 40 are generally

parallel to each other, the vehicle 410 travels in a generally straight direction.

Operation of the vehicle 410 is similar to the operation of the vehicle 10, with the added feature of being able to rotate and lock the beam  
5 127 using the locking lever 120 as described above.

Additionally, as shown in Fig. 11, in the vehicle 410, the motors 144, 146 are located on the same side of a central axis 162' coincident with the axle 162, as compared to the motors 44, 46 which are on opposite sides of the central axis coincident with the axle 62 as shown in the  
10 vehicle 10 in Fig. 4. The motors 144, 146 being on the same side of the central axis more evenly distributes the weight of the vehicle 410 about the geometric center of the vehicle 410, with the weight of the motors 144, 146 being offset by the weight of a power supply, such as batteries 150 which are located on the other side of the central axis from the motors 144, 146.  
15 The more even distribution of weight about the geometric center of the vehicle 410 allows the vehicle 410 to perform more uniformed and balanced stunts.

One of ordinary skill will appreciate that, although the motor means 42 preferably is electric, other means for moving the vehicle 10,  
20 including hydraulic, pneumatic, spring wound, flywheel or other inertial and electromagnetic prime movers could be used. One of ordinary skill will further appreciate that wired or tether control of the vehicle from a remotely located handset is also possible. Power or fuel also can be supplied from a source remote from the vehicle through a wire, pipe, optic fiber, etc.

Although the presently preferred embodiments of the toy vehicle 10, 210, 310, 410 are remotely controlled via radio signals, it should be understood that other types of remotely controlled (both hard wire and other types of wireless control) toy vehicles as well as toy vehicles which are not controlled are also within the scope of the invention. Thus, it is recognized that less expensive toy vehicles having some of the novel features of the invention can be made, notably a pivoting beam on at least one lateral side of the chassis, preferably allowing an infinite range of suspension travel, and are within the scope of the invention.

It will further be appreciated that, for instance, a wind-up or spring actuated motor or gasoline engine could be substituted for each electric motors of the present invention. It will further be appreciated that a vehicle of the present invention could also be provided with a single reversible prime mover with a drive train that permits a remotely controlled gear or other member to be engaged (or disengaged if previously engaged), when desired, to reverse the direction of the motor drive output to one of the first and second pairs of wheels, or disconnect that output, so that the vehicle can normally move forward or backward but will spin or turn in either direction when the remotely controlled gear or other member is moved. Also, twin motors can be provided to drive the same main gear for greater torque and the vehicle maneuvered as indicated above for a single prime mover. Similarly, a pair of prime movers can be provided but controlled together. One control switch on a remote control unit can be used to drive both motors in the same forward or backward linear driving

direction and another independent control switch can be used to control turning by reversing or disconnecting the power being supplied to one of the two motors. Still other arrangements are possible.

Furthermore, while a series of engaged spur gears are shown  
5 being used to transmit rotary motion, other types of members including drive shafts, belt or chain and pulley or the like and/or other types of gears can be used to transmit rotary motion from the prime mover to the beams(s) and wheels.

It will be understood by those of ordinary skill in the art that  
10 although the invention is described herein in terms of preferred, four-wheeled embodiments, the present invention could also comprise a vehicle having three wheels, or more than four wheels. Thus, the present invention is described in terms of a four-wheeled vehicle for convenience only, and is not to be limited to a four-wheeled vehicle.

15 Further, while it is preferred that all four wheels be of the same outside diameter, those skilled in the art will recognize that wheels of different outside diameters may be used at different locations on the vehicle  
10. For example, a first wheel in each of the first and second pairs of wheels  
30, 36 can be a different size than a second wheel in each of the first and  
20 second pairs of wheels 30, 36.

It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is

intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.



## CLAIMS

1. A toy vehicle comprising:
  - a chassis having first and second lateral sides;
  - a first pair of wheels located on the first lateral side;
  - a second pair of wheels located on the second lateral side;
  - at least one prime mover on the chassis drivingly coupled with at least one of the first pair of wheels; and
  - a first beam pivotally mounted to the first lateral side, the first pair of wheels being rotatably mounted on the first beam, distal from the chassis.
2. The toy vehicle according to claim 1, further comprising a second beam pivotally mounted to the second side of the chassis, the second pair of wheels being rotatably mounted on the second beam.
3. The toy vehicle according to claim 1 wherein the prime mover is a first electric motor drivingly coupled with the first pair of wheels and further comprising a second electric motor independently operable from the first motor and drivingly coupled with the second pair of wheels.
4. The toy vehicle according to claim 3 wherein the first electric motor is drivingly coupled with the first pair of wheels via a plurality of gears rotatably mounted on the first beam and the second

electric motor is drivingly coupled with the second pair of wheels via a like plurality of gears rotatably mounted on the chassis.

5. The toy vehicle according to claim 3, wherein a first drive pinion is drivingly connected with the first motor;

a first front wheel gear is fixedly mounted to a first front wheel of the first pair and drivingly couples the first front wheel with the first drive pinion;

a first rear wheel gear is fixedly mounted to a first rear wheel of the first pair and drivingly couples the first rear wheel with the first drive pinion;

a second drive pinion is drivingly connected with the second motor;

a second front wheel gear is fixedly mounted to a second front wheel of the second pair and drivingly couples the second front wheel with the second drive pinion; and

a second rear wheel gear is fixedly mounted to a second rear wheel of the second pair and drivingly couples the second rear wheel with the second drive pinion.

6. The toy vehicle according to claim 5, wherein at least one idler gear drivingly couples the first drive pinion with the first front wheel gear, a like number of idler gears drivingly couple the first drive pinion with the first rear wheel gear, a like number of idler gears drivingly couple the second drive pinion with the second front wheel gear, and a like

number of idler gears drivingly couple the second drive pinion with the second rear wheel gear.

7. The toy vehicle according to claim 6, wherein the idler gears are spur gears.

8. The toy vehicle according to claim 1 wherein the first beam is rotatable more than 360 degrees on the chassis.

9. The toy vehicle according to claim 1 wherein a second beam is mounted to the chassis, distal from the first beam, the second pair of wheels being rotatably mounted to the second beam.

10. The toy vehicle according to claim 1, wherein none of the wheels is steerably mounted to pivot with respect to the chassis about a vertical axis.

11. The toy vehicle according to claim 1, wherein a first wheel in each of the first and second pairs of wheels is a different size than a second wheel in each of the first and second pairs of wheels.

12. The toy vehicle according to claim 1, wherein the first beam can releasably lock to the chassis.

13. The toy vehicle according to claim 1 further comprising:

a one-way clutch drivingly coupling at least one of the second pair of wheels with the prime mover in one direction

14. The toy vehicle according to claim 13 further comprising a second one-way clutch drivingly coupling at least one of the

second pair of wheels with the prime mover in a direction opposite to the one direction of the first one-way clutch.

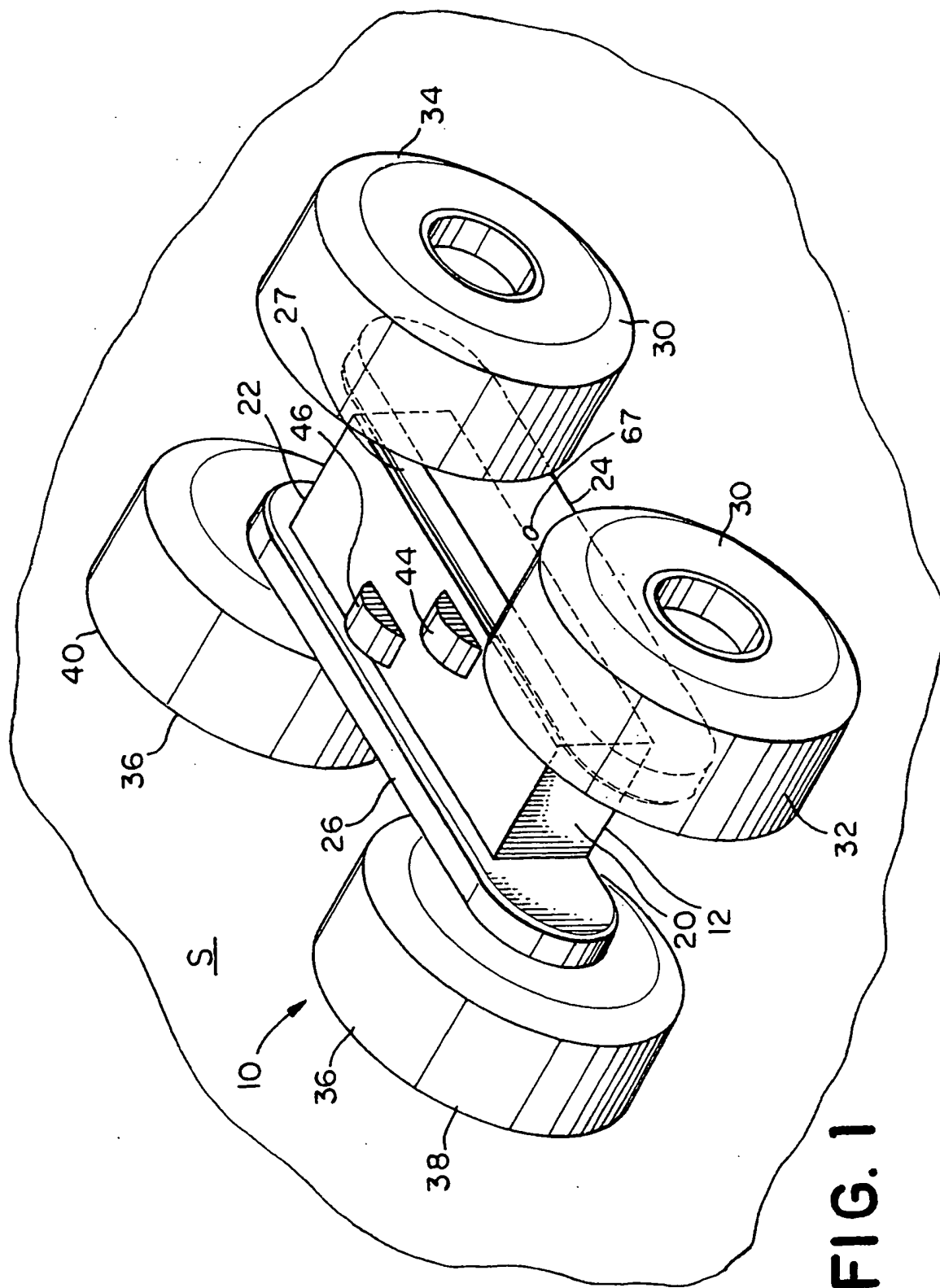
15. The toy vehicle according to claim 13 wherein the first beam is rotatable more than 360 degrees on the chassis.

16. The toy vehicle according to claim 13, wherein none of the wheels is steerably mounted to pivot with respect to the chassis about a vertical axis.

17. The toy vehicle according to claim 13, wherein the first beam can be releasably locked to the chassis.

18. The toy vehicle according to claim 13, wherein a first wheel in each of the first and second pairs of wheels is a different size than a second wheel in each of the first and second pairs of wheels.

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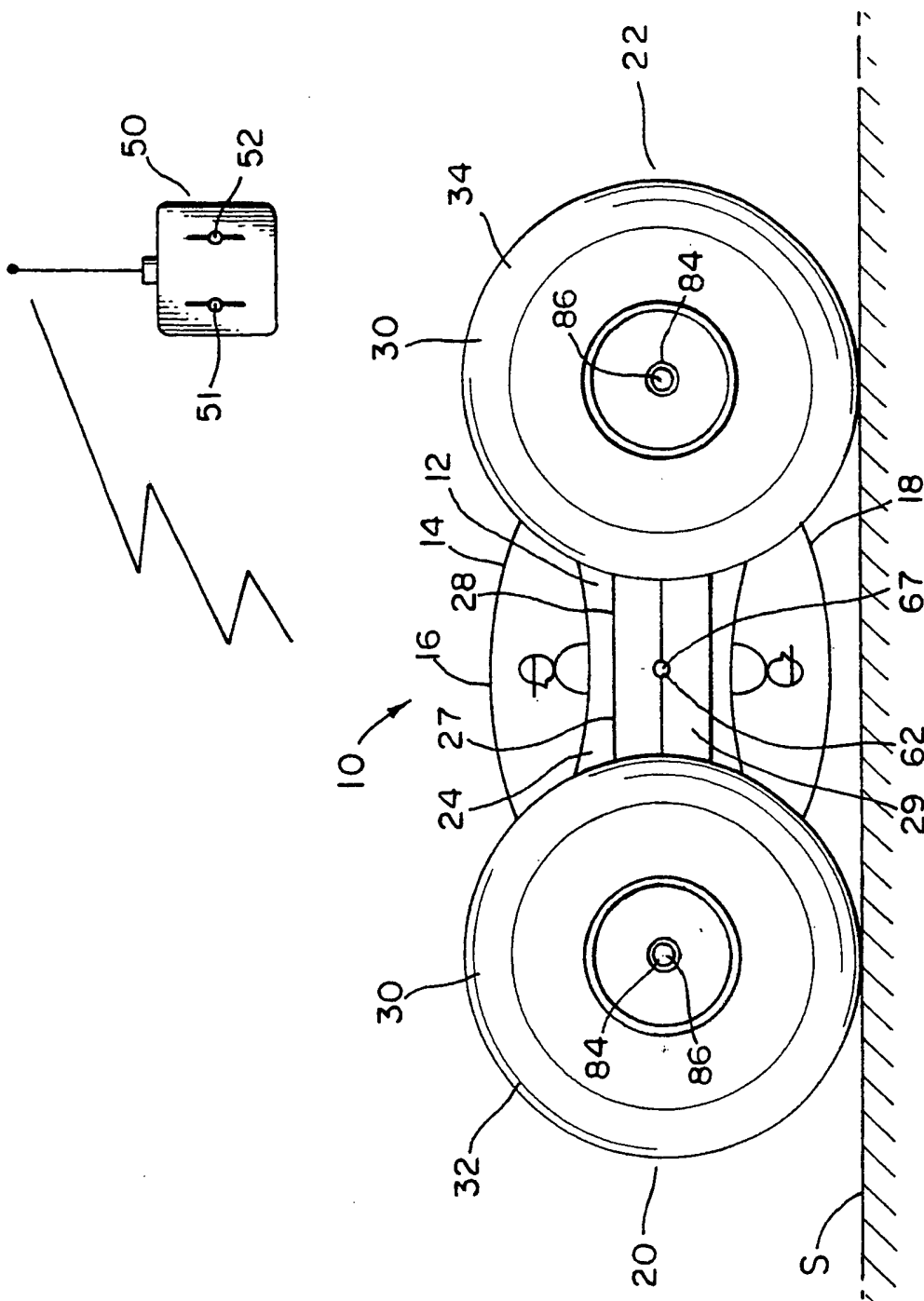


FIG. 2

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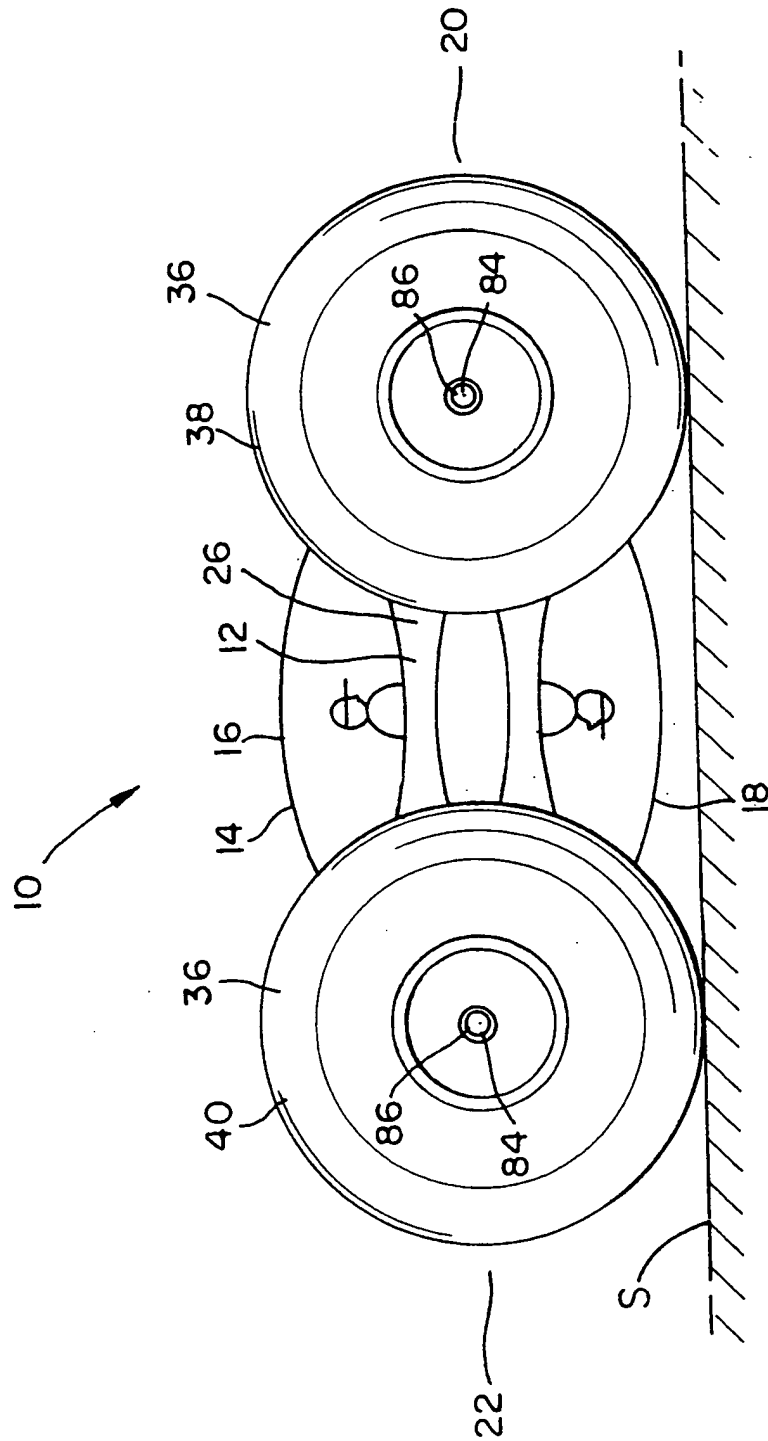


FIG. 3

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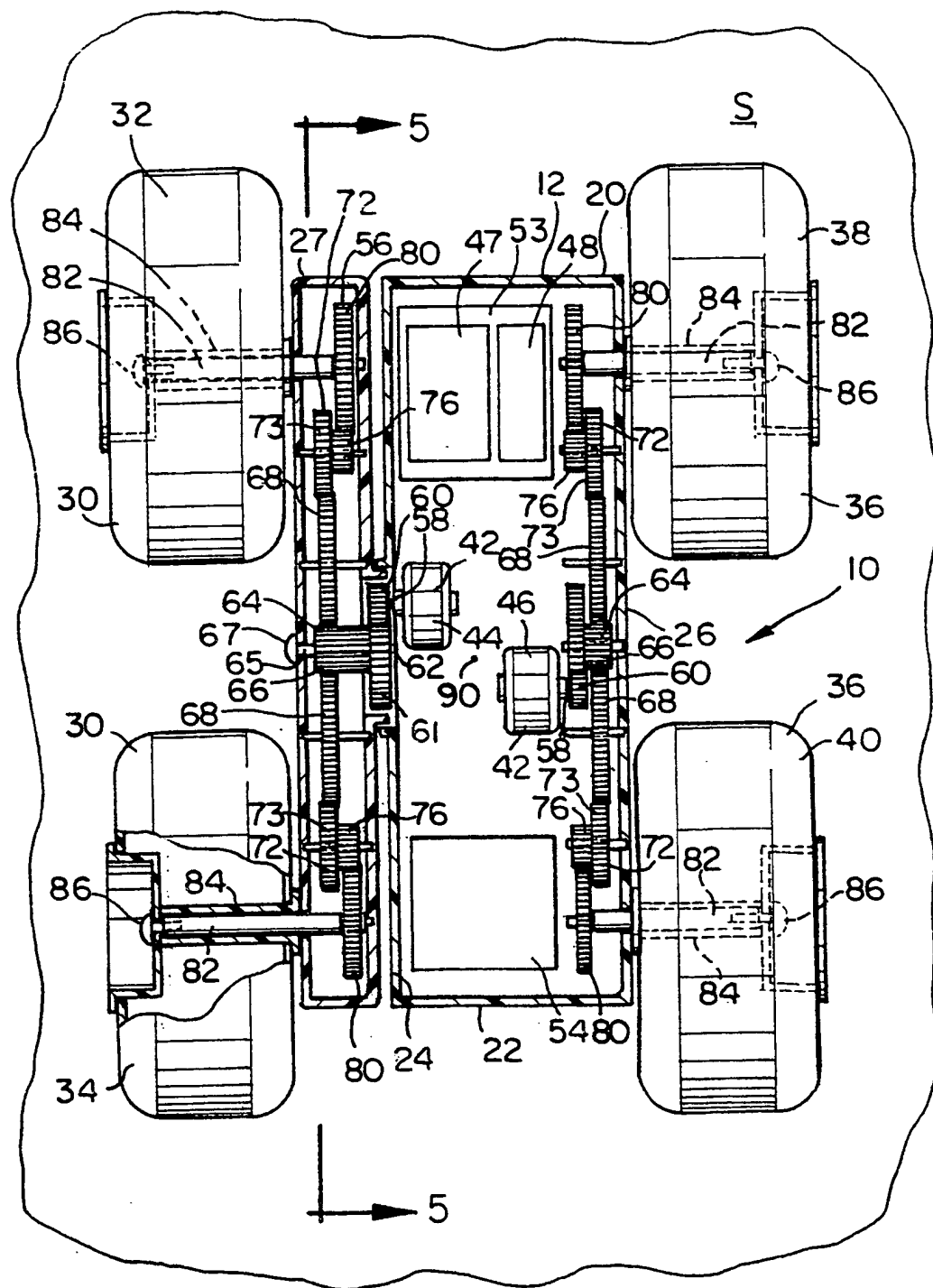
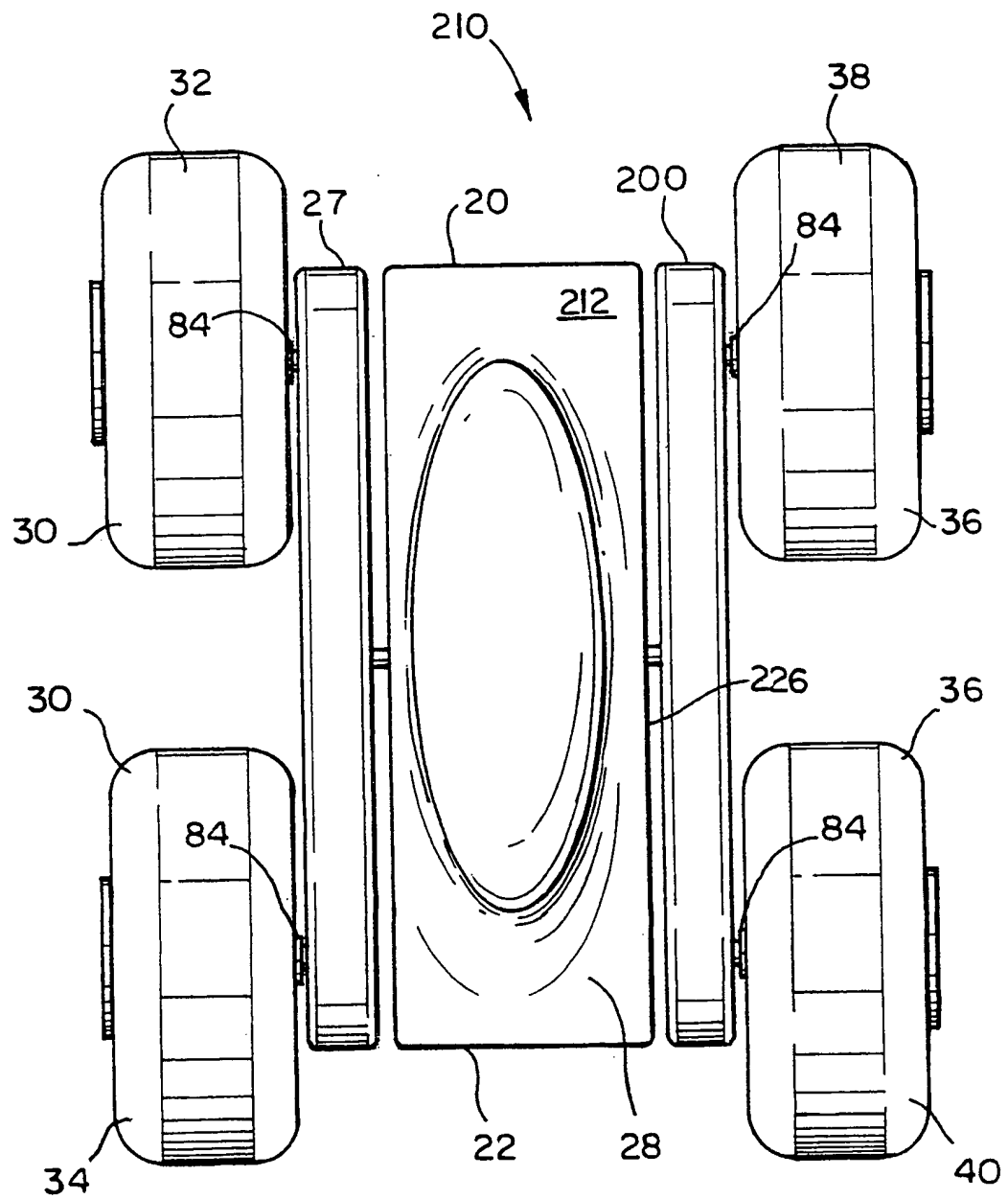


FIG. 4





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**FIG. 6**

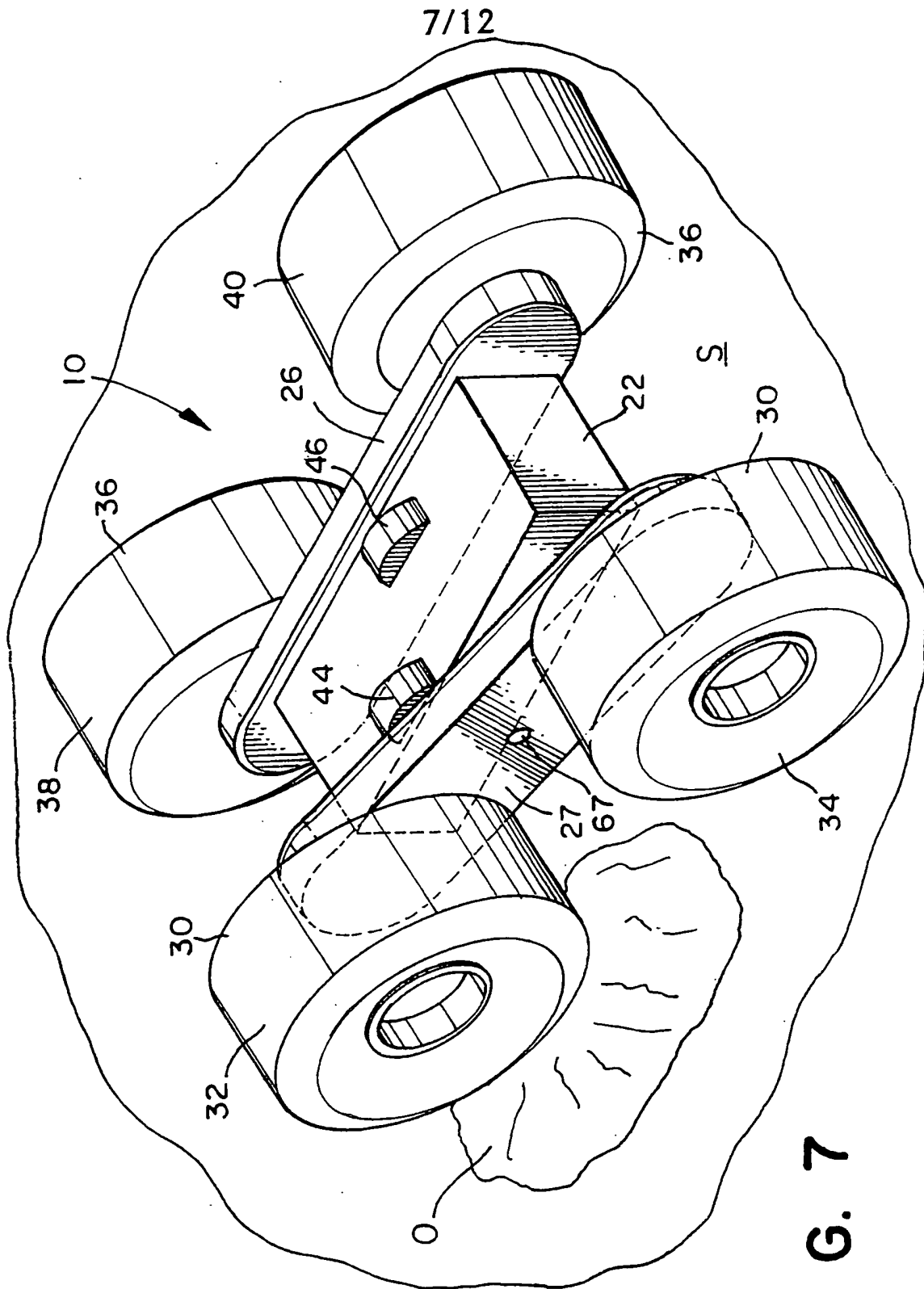


FIG. 7

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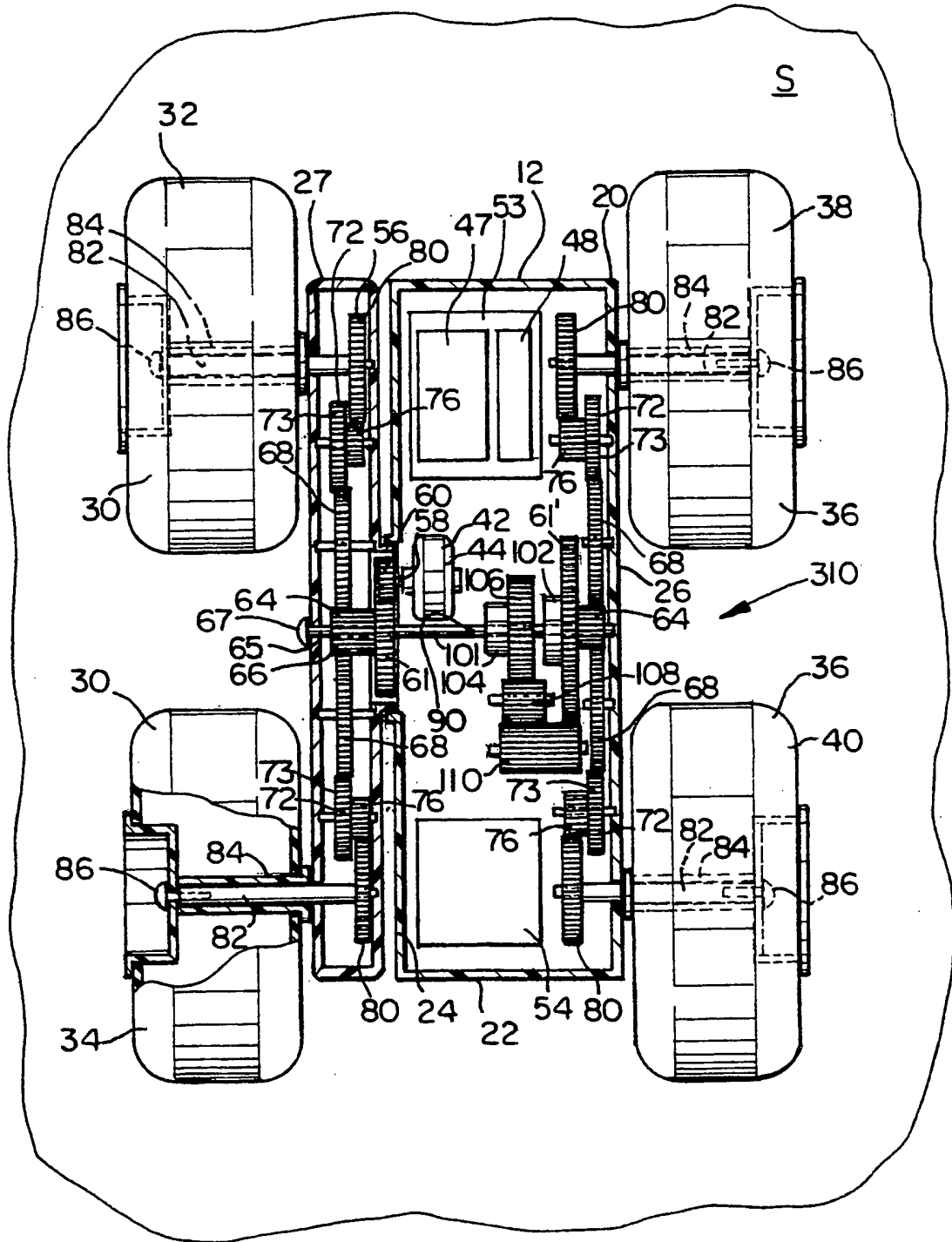


FIG. 8

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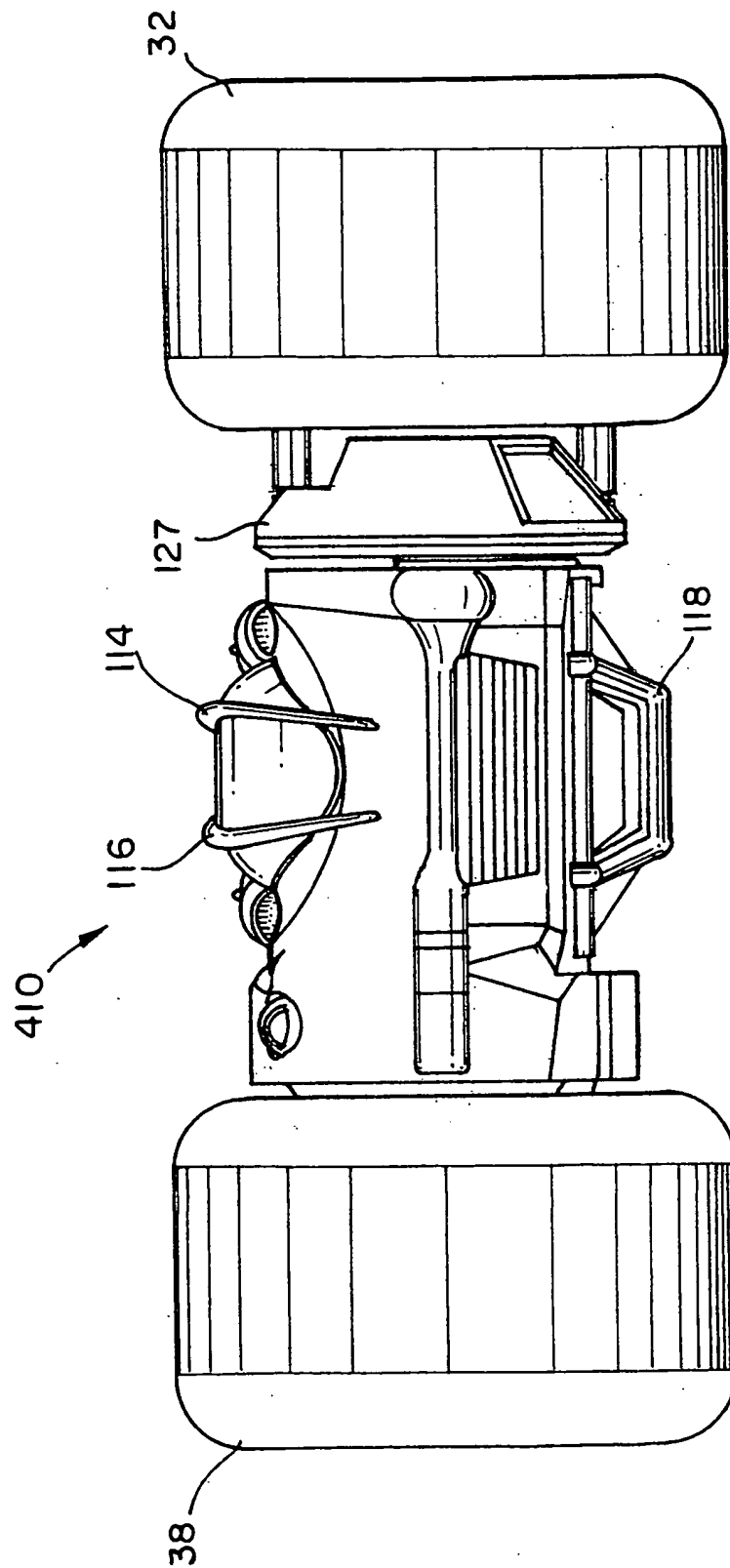


FIG. 9

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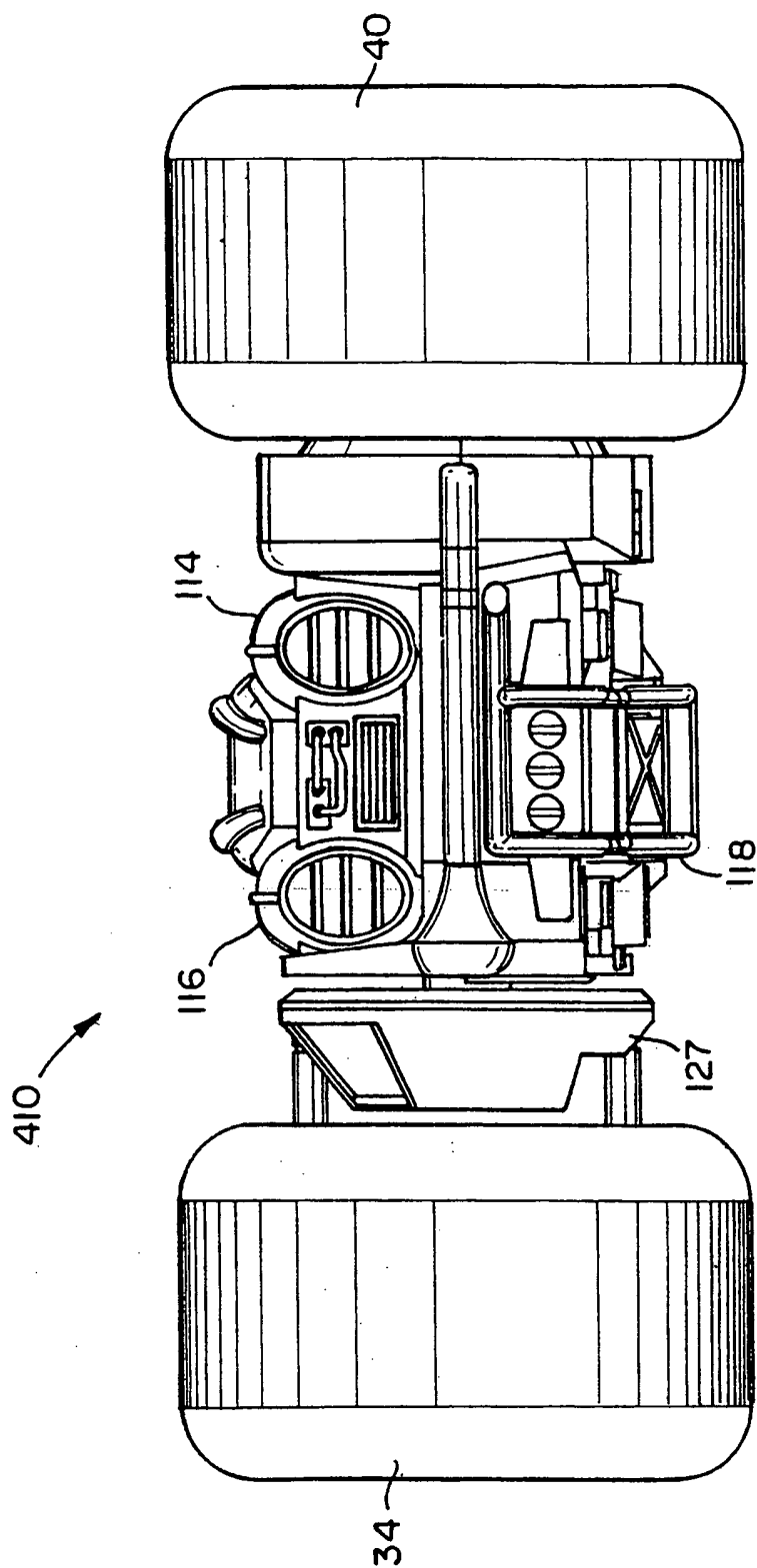
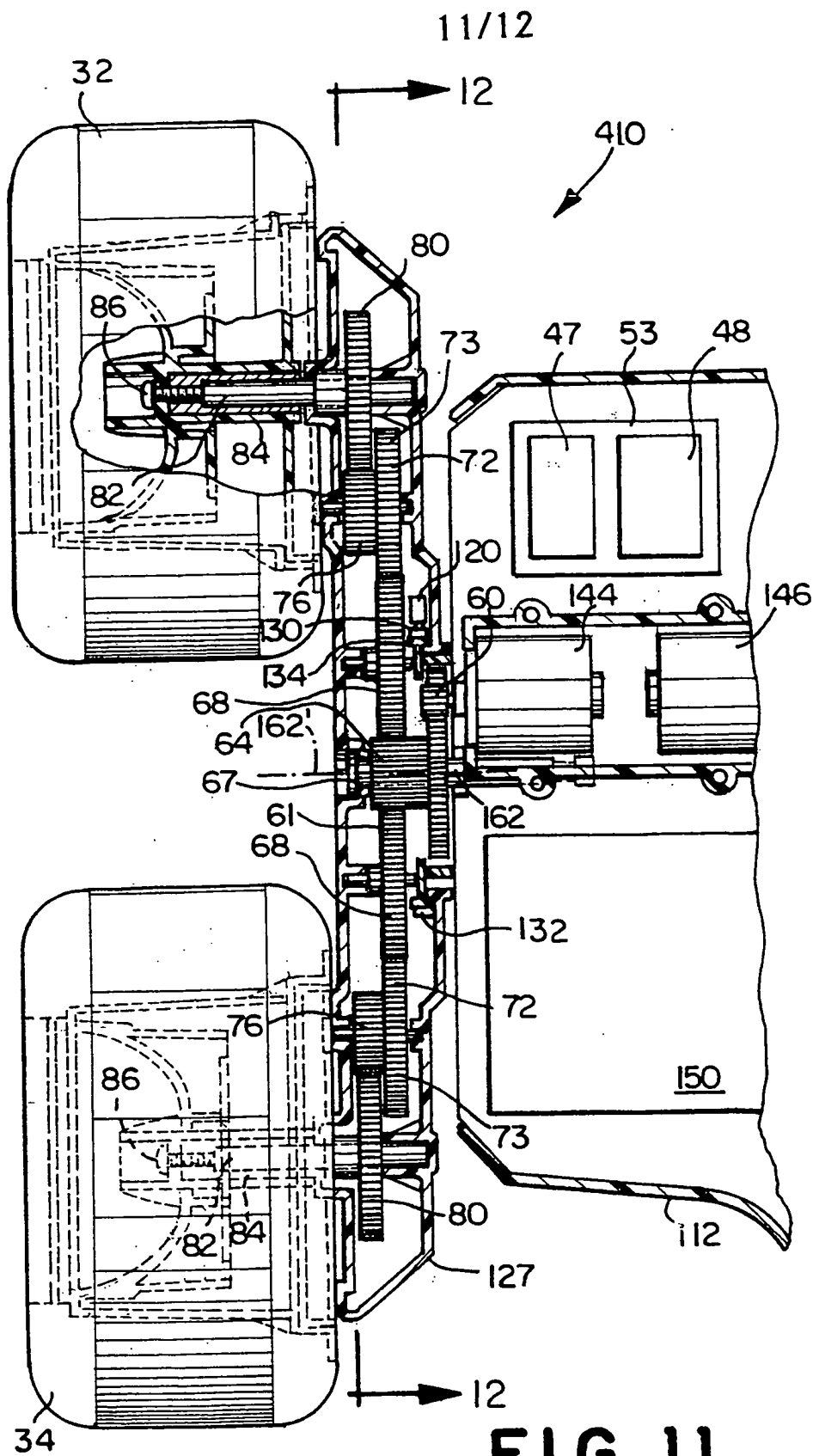


FIG. 10



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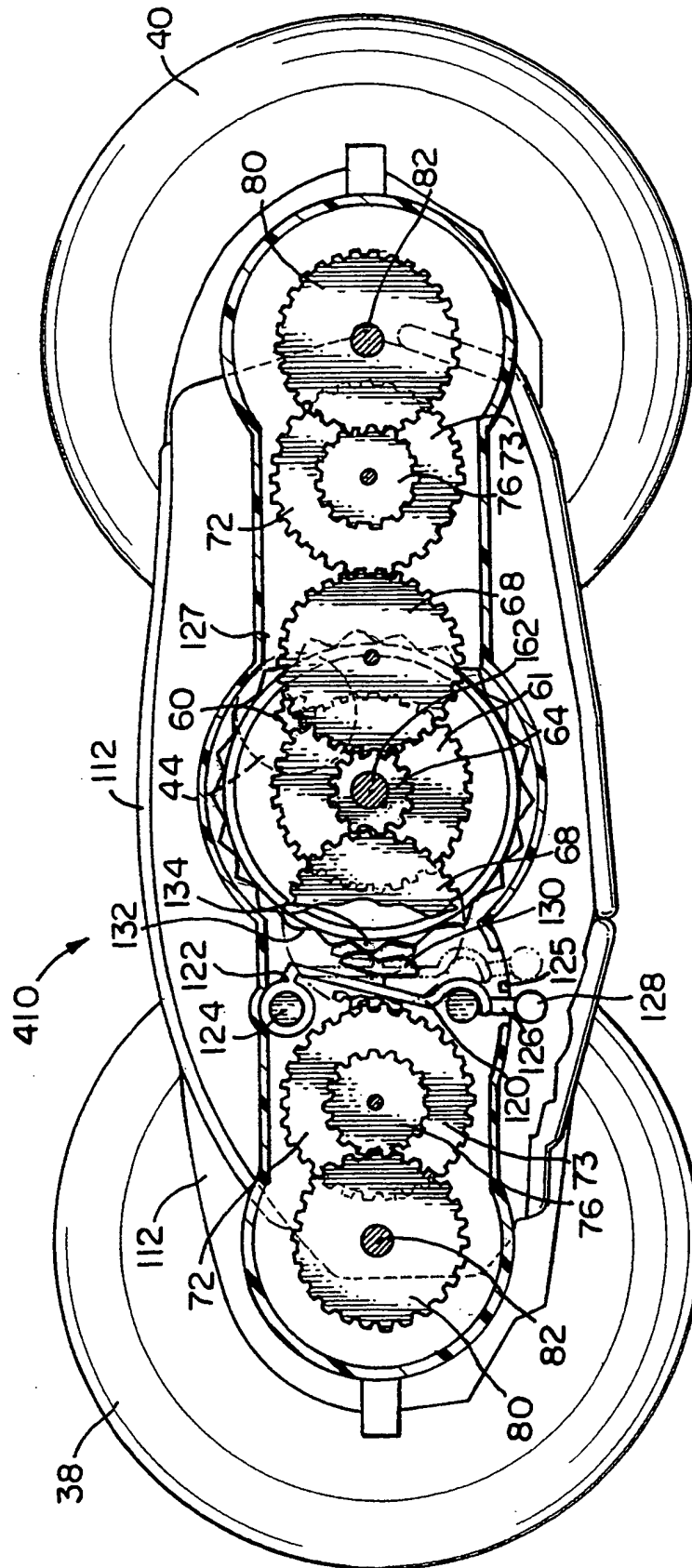


FIG. 12



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/18042

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A63H 17/32, 29/24, 17/26

US CL : 446/466, 460, 463

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 446/431, 433, 454, 456, 457, 460, 462, 463, 465, 466

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
none

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 3,849,931 A (GULLEY, JR.) 26 November 1974, see entire document.	1-5,9,10,12 6-8,11,13-18
Y	US 4,467,557 A (KUNA ET AL.) 28 August 1984, see fig 2.	6,7
Y	GB 2,118,851 A (OHNO) 09 November 1983, see figs 8-11d, 104.	8,11,15,18
Y	US 3,932,956 A (YOUNG) 20 January 1976, see figs 2 and 3.	13-18
Y	GB 2,131,309 A (ASANO) 20 June 1984, see fig 5.	13-18

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
13 OCTOBER 1999

Date of mailing of the international search report  
03 NOV 1999

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**Technology Center 3700**

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/18042

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,273,480 A (SUTO) 28 December 1993, see abstract and figs 7-14.	